What Factors Influence the City of Gunnison's Sales Tax Revenue?

A fundamental multivariate regression analysis identifying local economic factors that impact the City of Gunnison's sales tax revenue

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Abstract

Sales tax is the main revenue stream for the City of Gunnison. In order to maximize sales tax revenue, the local economy must operate at peak performance. Public officials rely on a healthy economic state to budget for the public needs. It is imperative to increase sales tax revenue to meet the growing demand for public goods. Multivariate regression analysis will determine the economic variables (CPI, labor force, etc.) that manipulate sales tax revenue the most. This will provide more insight on how to budget and control for lucrative economic cycles**.**

Introduction

Sales tax revenue is the main revenue stream for the City of Gunnison. The local government uses sales tax revenue to maintain, improve, and sustain public goods. It is imperative to have a strong and predictable revenue stream to keep up with local demands. However, in such a volatile economic state, it can be very difficult to budget sales tax revenue. Therefore it is vital to gain insight on economic factors that influence our sales tax revenue. This research paper is designed to identify those economic factors, and provide acumen for public officials to properly budget and forecast sales tax revenue. The method being used is multivariate regression analysis. This method attempts to explain movements in a dependent variable as a function of movements in a set of independent variables ($Y=B_0+B_1x_1+B_2x_2+.....+e$) (A.H., 2011). In other words, Y is our dependent variable (sales tax revenue), and B_nX_n is our independent variables (unemployment, civilian labor force, etc.). Essentially, we are testing the relationship between sales tax revenue and local economic factors.

There are two reasons why multivariate regression analysis is most appropriate for analyzing sales tax revenue. First, there are multiple reasons why an event exists; therefore we can simultaneously test multiple independent variables to one dependent variable. Secondly, economic factors are dynamic and it's very important to constantly adapt change. Using this analysis will allow us to measure the impact of one independent variable on the dependent variable, while holding the other independent variables constant (A.H., 2011). However, this method is not perfect. We won't be able to identify every factor involved. There are data limitations that disqualify significant variables. However, it can still provide insight on available variables.

Data

The City of Gunnison provided sales tax data from 1995 to 2014 (Figure 1).

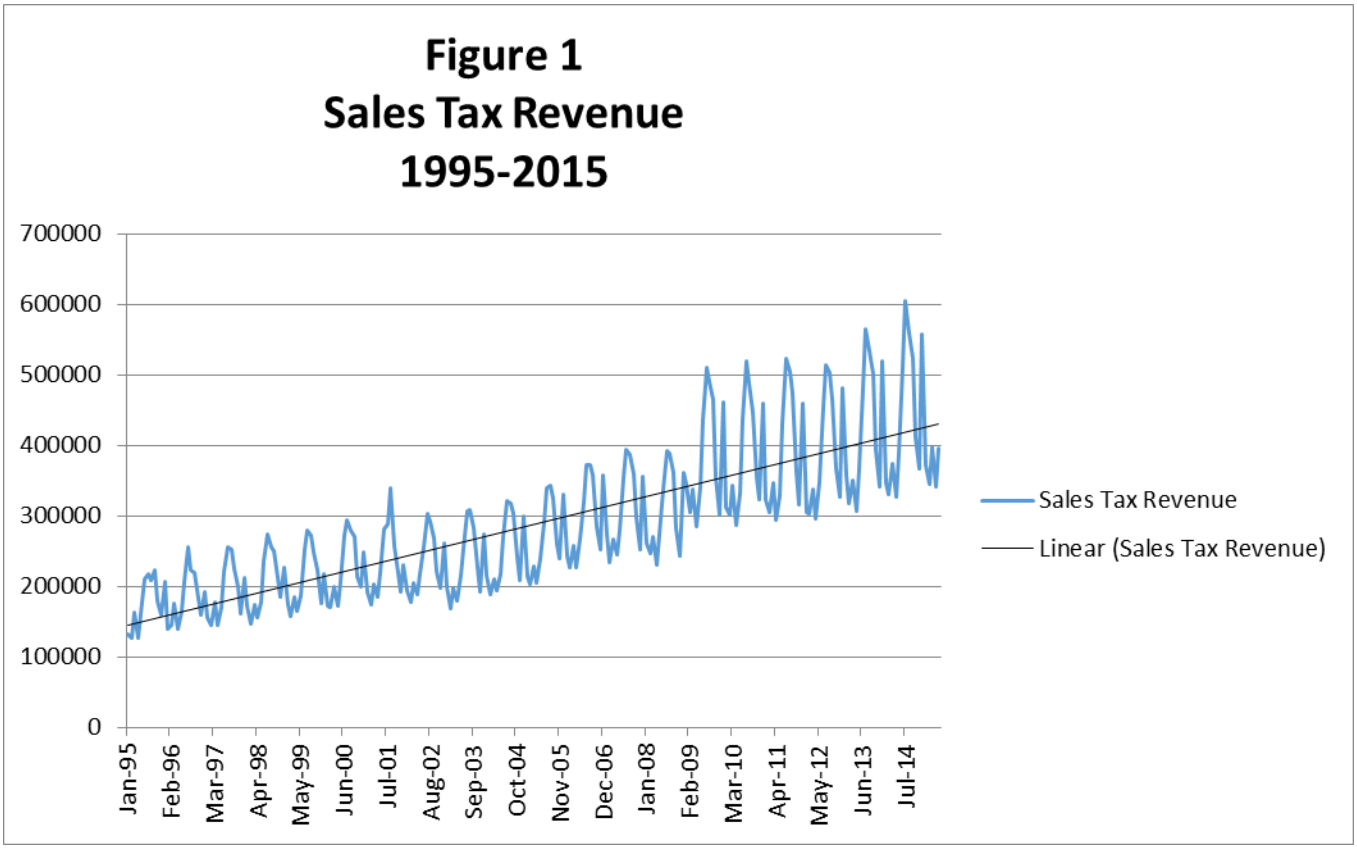

Figure 1 displays two critical components. First, volatility in the local economy has increased dramatically. Prior to 2009, our sales tax revenue was generally cyclical. However after 2009, this cyclical pattern became notably impulsive. Note, July of 2008, voters approved a one percent increase in sales tax. This may have some premise in instigating volatility, but it doesn't tell the whole story. Lastly, sales tax revenue has been increasing at a steady rate since January of 1995. This is proved by the linear regression line located in Figure 1. The formula to the linear regression line is Y = 144805.1996 + 1167.323576x. Hence the positive slope suggesting local economic growth.

Due to the lack of local economic data, three models were necessary to construct. Each model represents different data structures. The three models are labeled as 3, 5, & 7. Each model is a time series model from 1995-2013. The main difference among each model is the total amount of observations. For example, Model 3 is based upon monthly data sets (222 observations), versus Model 5 which is based on annual data sets (19 observations). Conversely, Model 7 extracts unique independent variables not used in Models 3 & 5.

Empirical Results

This section will analyze the results of Models 3, 5, & 7. It will accomplish three main objectives: Identification of differences, relative importance, and summarization of essentials.

Model 3

Model 3 required monthly data sets ranging from January 1995 to June 2013 (222 observations). The number of observations contributed to an effective multivariate regression analysis. However, Model 3 lacks independent variables (unfortunately data sets with this series are hard to come by). The independent variables are Number of Persons Unemployed[1], Civilian Labor Force, Trash in Cubic Yards, and SNAP beneficiaries in Colorado. The Number of Persons Unemployed, Civilian Labor Force, and SNAP beneficiaries are found on https://research.stlouisfed.org/. The trash variable is attributed to Gunnison County landfill.

I hypothesized that the Number of Persons Unemployed will have a negative correlation with sales tax revenue. Theory suggests that effective demand[2] is equal to income (Britannica, 2015). Effectively, if one is unemployed there is a lack of financial resources, and consumption

[1] Civilian Labor force * (Unemployment rate/100)
[2] Demand is the immediate rate of consumption
http://www.stonybrook.edu/sustainability/energy/facts/demand.shtml

will decrease. Therefore an increase in the Number of Persons Unemployed would decrease aggregate consumption, thus decreasing sales tax revenue. The logical assumption proposes people's only monetary resources come from employment[3] (obviously this is not always true, yet it is important to assume for legitimacy purposes).

Next, I speculated civilian labor force would increase sales tax revenue. An increase in civilian labor force doesn't necessarily increase employment. Instead there would be an increase in the number of people seeking work. If the total working population is relatively stable, an increase in civilian labor force will increase participation rate[4]. Data shows Gunnison County's overall population[5] has been growing relatively slow. For this reason, the participation rate in Gunnison should increase[6]. However job availability must be growing at the same rate as the participation rate. As indicated before (Figure 1), the local economy is growing, as result job availability should also grow. The combination of increasing both job availability and participation rate suggests an increase in employment. Theory suggests that an increase in employment will increase monetary resources. Logically, we can assume a consumption increase, thus leading to an increase in sales tax revenue.

Trash in cubic yards is an interesting variable in itself. I hypothesize that trash is positively correlated with sales tax revenue. Rationally assuming, as consumption increases, trash will increase, thus increasing sales tax revenue. Note the logical postulation is landfill trash is derived from the local economy. In this case, trash is a proxy for consumption.

[3] Budget Constraint Theory http://www.economicshelp.org/blog/glossary/budget-constraints/
[4] Labor force participation= Civilian labor force/Civilian non-institutionalized population. Note total population is a proxy for Civilian non-institutionalized population in my research due to lack of data resources
[5] Gunnison's total population is used as a substitute for total working population
[6] If we use Gunnison's total population as a surrogate for Gunnison's working population

Lastly, SNAP beneficiaries in Colorado are suspected to have positive correlation with sales tax revenue. Government assistance (SNAP) aids people who lack monetary resources. In essence, SNAP is increasing the money supply in the local economy. This increases consumption and ultimately increases sales tax revenue. An important assumption being made is SNAP beneficiaries will spend local. There is no monthly data series available to support the number of SNAP beneficiaries in Gunnison County. Consequently, SNAP beneficiaries of Colorado will be a proxy for Gunnison County SNAP beneficiaries.

Model 3

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.883[a]	.780	.776	43443.53421

a. Predictors: (Constant), Snap, Trash, CivilianLF, NumberofUnemployed

Descriptive Statistics

	Mean	Std. Deviation	N
SalesTaxRev	273189.9542	91859.61529	222
NumberofUnemployed	418.9585	126.24957	222
CivilianLF	8876.4414	848.19587	222
Trash	4712.9223	1607.09252	222
Snap	270506.4955	106377.47015	222

Correlations

	SalesTaxRev	NumberofUnemployed	CivilianLF	Trash	Snap
Pearson Correlation	1.000	.289	.677	.493	.685
	.289	1.000	.265	-.091	.727
	.677	.265	1.000	.006	.674
	.493	-.091	.006	1.000	.058
	.685	.727	.674	.058	1.000

Coefficients

Model		Unstandardized Coefficients		Sig.	Collinearity Statistics	
		B	Std. Error		Tolerance	VIF
1	(Constant)	-271309.093	45794.839	.000		
	NumberofUnemployed	-106.089	38.723	.007	.357	2.799
	CivilianLF	39.020	5.262	.000	.429	2.333
	Trash	25.578	1.878	.000	.938	1.066
	Snap	.451	.060	.000	.211	4.750

Model 3 displays five major constituents. First, the adjusted R squared[7] is .776. Meaning, the dependent variables explain the movements in our sales tax revenue 77.6% of the time. Second, each independent variable is statistically significant (must be below .05). Third multicollinearity is not present. The Pearson Correlation[8] does not identify a variable with a correlation coefficient greater than .80. To verify validity, the VIF[9] will help support this claim. Model 3 exhibits a VIF with a value no greater than 5, thus proving low multicollinearity. Fourth, there is inconclusive evidence that serial correlation exists. Serial correlation[10] is how the past observations affect the future observations. In many time series models serial correlation is existent. Model 3 exemplifies inconclusive evidence[11] that serial correlation is present; this is

[7] R squared measures the overall strength of regression analysis
[8] A dependent variable must have correlation coefficient greater than .80 to possess multicollinearity (A.H., 2011)
[9] Variance Inflation Factor (A.H., 2011). A high VIF will indicate multicollinearity.
[10] Pure serial correlation occurs when classical assumption IV is violated; uncorrelated observations of the error term are violated (A.H., 2011).
[11] Decision rule for Durbin-Watson (A.H., 2011)
If $d < 1.2$ Positive serial correlation
If $d > 1.65$ No positive correlation
If $1.2 \leq d \leq 1.65$ Inconclusive Region

indicated by the Durbin-Watson value of 1.206. Lastly, Model 3 can be expressed as the function, SalesTaxRevenue = -271309.093 + 106.089NumberofUnemployed + 39.020CivilianLF + 25.578Trash + .451SNAP.This shows that for every one unit increase in the number of unemployed, holding all other variables constant, the sales tax revenue goes down $106.74. For every one unit increase in the number of Civilian Labor Force, holding all other variables constant, the sales tax revenue goes up $39.020. For every one unit increase in the number of Trash in cubic feet, holding all other variables constant, the sales tax revenue goes up $25.57. Lastly, for every one unit increase in the number of SNAP beneficiaries in Colorado, holding all other variables constant, the sales tax revenue goes up $.45.

To summarize the essentials of Model 3 there are three main characteristics to remember. First, Model 3 is robust with an adjusted R squared of .776. Second, the independent variables are statistical significant in explaining sales tax revenue. Lastly, the number of unemployed persons had the largest monetary effect on sales tax revenue.

Model 5

Model 5 is unique in its own way. First it requires an annual data set dating back from 1995 to 2011 (17 observations). This doesn't give significant amount of observations for multivariate regression analysis to be effective. However, it will still display existing relationships. Secondly, there was an abundance of independent variables measured: Per Capita Income, Gunnison County SNAP Beneficiaries, Number of People Unemployed, WSCU Enrollment, Total Jobs, Population, and Civilian Labor Force.

Per Capita Income, Gunnison County SNAP Beneficiaries, Number of People Unemployed, Population, and Civilian Labor Force can be found at https://research.stlouisfed.org/. Data on enrollment is accredited to Western State Colorado University, and Total jobs are attributed by Colorado Department of Local Affairs[12].

I suspected per capita income to be positively correlated with sales tax revenue. Per capita income is a measure of the amount of money being earned per person in a certain area (Investopedia.com). Economic theory[13] would suggest as income increases consumption will increase, thus increasing sales tax revenue.

Next, I hypothesized that Gunnison County SNAP beneficiaries will positively correlate with the sales tax revenue. This variable differs from Model 3, because these are actual Gunnison County SNAP beneficiaries not Colorado SNAP beneficiaries. This will still increase the money supply in the local economy; which increases consumption and ultimately increases sales tax revenue.

Next, I theoretical assumed Number of Unemployed Persons in Gunnison County will be negatively correlated with sales tax revenue. As suggested in Model 3, theory suggests that effective demand[14] is equal to income (Britannica, 2015). Effectively, if one is unemployed there is a lack of financial resources, and consumption will decrease. Therefore an increase in the Number of Persons Unemployed would decrease aggregate consumption, thus decreasing sales tax revenue.

[12] http://www.colorado.gov/cs/Satellite?c=Page&childpagename=DOLA-Main%2FCBONLayout&cid=1251593348674&pagename=CBONWrapper
[13] http://economicsconcepts.com/theory_of_ordinal_utility.htm
[14] Demand is the immediate rate of consumption http://www.stonybrook.edu/sustainability/energy/facts/demand.shtml

Regarding Civilian Labor Force, I made the same predication in Model 3 as I did with Model 5. An increase in civilian labor force would increase sales tax revenue. If the total working population is relatively stable, an increase in civilian labor force will increase participation rate. The combination of increasing both job availability and participation rate suggests an increase in employment. Theory suggests that an increase in employment will increase monetary resources. Logically, we can assume a consumption increase, thus leading to an increase in sales tax revenue.

I speculated WSCU Enrollment and Population to be positively correlated with the sales tax revenue. Logically, more people added to the local economy will increase spending thus increasing sales tax revenue. This is not always true, because the people added to the local economy don't necessarily contribute to the money supply. In general I am making the assumption that these people have the financially capacity to spend locally.

Lastly, I hypothesized that an increase in Total Jobs will increase sales tax revenue. However, these added jobs in the local economy must be filled. An increase in total jobs must be met with an increase in the participation rate and hiring rate. If these jobs are not being filled then employment will not increase. The local economy will be stuck with an abundance of added jobs but no one to work these jobs. Therefore assuming added jobs are being filled, it will increase employment, thus increasing consumption, and finally increasing sales tax revenue.

Model 5

Descriptive Statistics

	Mean	Std. Deviation	N
SalesTaxRevenue	3379796.1657	998528.11747	17
SNAP	418.1176	167.09461	17
Total Jobs	10589.8235	592.24596	17
NumberofUnemployed	407.0652	116.36418	17
Per Capita Income	27960.0588	5968.61973	17
Enrollment	2328.8824	139.47620	17
Pop	5473.4706	259.05070	17
CVLF	8796.0343	735.08894	17

Correlations

	SalesTaxRevenue	SNAP	Total Jobs
Pearson Correlation	1.000	.632	.703
	.632	1.000	-.052
	.703	-.052	1.000
	.225	.747	-.401
	.904	.458	.788
	-.853	-.285	-.851
	.926	.620	.641
	.934	.611	.704

Correlations

NumberofUnemployed	Per Capita Income	Enrollment	Pop	CVLF
.225	.904	-.853	.926	.934
.747	.458	-.285	.620	.611
-.401	.788	-.851	.641	.704
1.000	-.040	.222	.182	.260
-.040	1.000	-.888	.893	.916
.222	-.888	1.000	-.818	-.770
.182	.893	-.818	1.000	.888
.260	.916	-.770	.888	1.000

Model Summary

Model	R	R Square	Adjusted R Square	Durbin-Watson
5	.982[a]	.963	.935	2.592

Coefficients

Model		Unstandardized Coefficients		Sig.	Collinearity Statistics
		B	Std. Error		VIF
1	(Constant)	-4850359.665	7180960.543	.516	
	SNAP	1821.193	1280.999	.189	11.287
	Total Jobs	773.272	472.220	.136	19.268
	NumberofUnemployed	2049.380	1547.101	.218	7.984
	Per Capita Income	21.030	49.910	.683	21.861
	Enrollment	-1858.997	1484.634	.242	10.563
	Pop	594.035	702.061	.419	8.148
	CVLF	-121.009	483.574	.808	31.128

Model 5 displays five major essentials. First, the adjusted R squared[15] is .935. Meaning, the dependent variables explain the movements in our sales tax revenue 93.5% of the time. Second, the independent variables are hardly significant; each variable is greater than .05 (located under Sig.). Third multicollinearity is present. The Pearson Correlation[16] does identify variables with a correlation coefficient greater than the absolute value of.80. Also the VIF[17] exhibits a value greater than 5, thus proving high multicollinearity. Fourth, there is conclusive evidence that serial correlation doesn't exist; this is indicated by the Durbin-Watson value of

[15] R squared measures the overall strength of regression analysis
[16] A dependent variable must have correlation coefficient greater than .80 to possess multicollinearity (A.H., 2011)
[17] Variance Inflation Factor (A.H., 2011). A high VIF will indicate multicollinearity.

2.592. Lastly, Model 5 can be expressed as the function, SalesTaxRevenue = -4850359.665 + 1821.193SNAP + 773.27TotalJobs + 2049.38NumberofPersonUnemployed + 21.030PerCapitaIncome -1858.997Enrollment + 594.03Population -121.009CivilianLaborForce.

This shows that for every one unit increase in the SNAP beneficiaries, holding all other variables constant, the sales tax revenue goes up $1821.193. For every one unit increase in the number of Total Jobs, holding all other variables constant, the sales tax revenue goes up $773.272. For every one unit increase in the Number of Unemployed Persons, holding all other variables constant, the sales tax revenue goes up $2049.380. For every one unit increase in the Per Capita Income, holding all other variables constant, the sales tax revenue goes up $21.030. For every one unit increase in Enrollment, holding all other variables constant, the sales tax revenue goes down $1858.99. For every one unit increase in the Population, holding all other variables constant, the sales tax revenue goes up $594.035. For every one unit increase in the Civilian Labor Force, holding all other variables constant, the sales tax revenue goes down $121.009.

To summarize the essentials of Model 5 there are four main characteristics to remember. First we have a strong model with an adjusted r square of 93.5%. Second, even though are model is strong none of the variables are statistically significant. However, I kept the variables in the model to satisfy economic theory. This model still shows relative correlations. Third, enrollment and civilian labor force had a negative correlation. It may be possible that enrollment has a negative correlation because in today's society college kids are known for their lack of monetary resources. However, civilian labor force is still a mystery and can be

explained by omitted variable bias. This suggests that there is a variable out there not added to the model. Lastly, the number of unemployed persons had a negative correlation with sales tax revenue. This again could be from omitted variable bias.

Model 7

Model 7 is a monthly model based upon different market sectors in the economy. Sales tax revenue is divided into twelve categories (in this case the independent variables): apparel/clothing stores, building materials and trade, gas/convenience stores, department and hardware stores, furniture/appliance stores, utilities, grocery stores, hotel/motel/lodging, vehicle sales, restaurant/bar/liquor stores, specialty shops, and miscellaneous retail. Model 7 identifies which one of these sectors affects sales tax revenue the most. The twelve different categories are measured by monthly sales tax revenue, which is provided by the City of Gunnison.

Due to the purpose of strictly measuring effect, there will not be a hypothetical analysis of the independent variables. Mainly, there is no economic theory supporting the claim of each variable. Again, Model 7 is strictly identifying individual market sector correlation.

Model 7

Descriptive Statistics

	Mean	Std. Deviation	N
SalesTaxRevenue	304544.9436	112062.14686	240
Utilities	20632.4233	7545.00975	240
GroceryStore	76533.8323	35681.39173	240
Hotel	11233.5294	7972.61746	240
Restaurant	45998.7209	18370.68754	240
Specialty	27605.7928	8924.55642	240
Apparel	4838.8438	1888.89323	240
Bldmat	10909.5195	5110.88690	240

		SalesTaxRevenue	Utilities	Grocery Store
Pearson Correlation		1.000	.573	.919
		.573	1.000	.687
		.919	.687	1.000
		.797	.118	.628
		.928	.450	.830
		.723	.155	.642
		.591	-.075	.523
		.832	.370	.703

Hotel	Restaurant	Specialty	Apparel	Bldmat
.797	.928	.723	.591	.832
.118	.450	.155	-.075	.370
.628	.830	.642	.523	.703
1.000	.899	.759	.713	.738
.899	1.000	.698	.601	.825
.759	.698	1.000	.699	.612
.713	.601	.699	1.000	.468
.738	.825	.612	.468	1.000

Model Summary

Model	R	R Square	Adjusted R Square	Durbin-Watson
1	.975[a]	.951	.950	.721

Coefficients

Model		Unstandardized Coefficients		Sig.	Collinearity Statistics
		B	Std. Error		VIF
1	(Constant)	11608.571	10549.639	.272	
	Utilities	2.148	.456	.000	4.472
	GroceryStore	1.138	.134	.000	8.653
	Hotel	2.118	.772	.007	14.305
	Restaurant	1.170	.398	.004	20.225
	Specialty	.831	.324	.011	3.169
	Apparel	3.317	1.562	.035	3.288
	Bldmat	4.120	.573	.000	3.238

Model 7 displays three major elements. First, the adjusted R squared[18] is .95. Meaning, the dependent variables explain the movements in our sales tax revenue 95% of the time. Second, the independent variables are very significant; each variable is less than .05 (located under Sig.). Third multicollinearity is present among independent variables. The Pearson Correlation[19] does identify variables with a correlation coefficient greater than the absolute value of.80. Interestingly, the VIF[20] exhibits a value greater than 5 only among grocery stores, hotels and restaurants. Fourth, there is conclusive evidence that serial correlation exist; this is

[18] R squared measures the overall strength of regression analysis
[19] A dependent variable must have correlation coefficient greater than .80 to possess multicollinearity (A.H., 2011)
[20] Variance Inflation Factor (A.H., 2011). A high VIF will indicate multicollinearity.

indicated by the Durbin-Watson value of 2.592. Lastly, Model 7 can be expressed as the function, SalesTaxRevenue = -11608.571 + 2.1Utilites + 1.1Grocerystores + 2.1Hotel + 1.17Restaurant + .831SpecialtyShops + 3.3Apparel + 4.12BldMat.

Model 7 exhibits two behaviors that can be taken away. First, grocery stores, lodging, and restaurants are all correlated together, and are most significant in explaining sales tax revenue. Second, Model 7 is very strong with significant independent variables. This is to be expected because the measure for the market sectors is derived from annual sales tax revenue. However, it is interesting to know that utilities, grocery stores, lodging, restaurants, specialty shops, apparel, and building material explain sales tax revenue the best.

Conclusion

Sales tax revenue is the main revenue stream for the City of Gunnison. The local government uses sales tax revenue to maintain, improve, and sustain public goods. It is imperative to have a strong and predictable revenue stream to keep up with local demands. The best method to predict this revenue stream is multivariate regression analysis.

Model 3 used monthly sales tax revenue as the dependent variable and Number of Persons Unemployed, Civilian Labor Force, Trash in Cubic Yards, and SNAP beneficiaries in Colorado as the independent variables. Model 3 was strong with a .776 adjusted r square and the independent variables are statistical significant. The number of unemployed persons had the largest monetary effect on sales tax revenue.

Model 5 is annual data set with sales tax revenue as its dependent variable and Per Capita Income, Gunnison County SNAP Beneficiaries, Number of People Unemployed, WSCU

Enrollment, Total Jobs, Population, and Civilian Labor Force as its independent variables. Model 5 was a strong model with an adjusted r square of .935; however none of the variables are statistically significant. Enrollment, number of persons unemployed, and civilian labor force had a negative correlation. The main argument from Model 5 is there are a multitude number of independent variables that explain sales tax revenue.

Model 7 is a monthly model based upon 12 different market sectors in the economy. The twelve different categories are measured by monthly sales tax revenue, which is derived from total sales tax revenue. Model 7 exhibited that grocery stores, lodging, and restaurants are all correlated together, and are most significant in explaining sales tax revenue. Model 7 is very strong with significant independent variables.

To conclude all models, the number of person's unemployed, SNAP beneficiaries, grocery stores, hotels, and restaurants has the biggest impact on sales tax revenue. Public officials can now make executive financial decisions based upon this analysis.